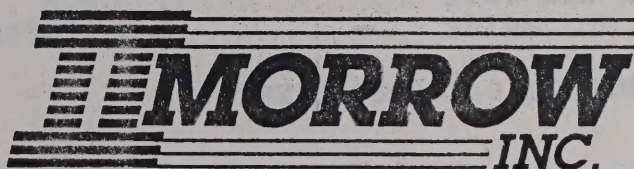




MODEL 604
LORAN-C NAVIGATION SYSTEM
INSTALLATION MANUAL



SALEM, OREGON U.S.A.

MANUFACTURER OF QUALITY NAVIGATION AND COMMUNICATION SYSTEMS

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FACTORY

2345 Turner Rd., S.E.
Salem, Oregon 97302 USA

(503) 581-8101

FACTORY

P.O. Box 13549
Salem, OR 97309

TWX 5105990110 II MORROW SAM

EAST COAST SERVICE CENTER

411 Telegraph Rd., Suite 203
Odenton, MD 21113
(301) 674-6050 1-800-831-6050

SOUTHEAST SERVICE CENTER

102 S. 22nd St., Tampa, FL 33605
(813) 247-4912

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INSTALLATION MANUAL

SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides information about the electrical, mechanical, and physical characteristics as well as installation procedures for the APOLLO Model 604 LORAN-C Navigation System by II Morrow, Inc. Follow the procedures recommended in this manual for successful installation and optimum performance.

1.2 EQUIPMENT DESCRIPTION

The APOLLO is a panel mounted LORAN-C receiver as illustrated in Figure 1. A slotted screw secures the APOLLO to the mounting frame. Removal of the screw allows for the easy transfer of the receiver.

The A-16 LORAN-C Whip Antenna by II Morrow Inc. is included as the standard antenna with the APOLLO Model 604 package. The A-16 is rated to 350 kts (TAS). The A-17 LORAN-C High Speed Blade Antenna is rated to 521 kts (TAS). The A-23 LORAN-C Bent Whip Antenna is rated to 350 kts (TAS).

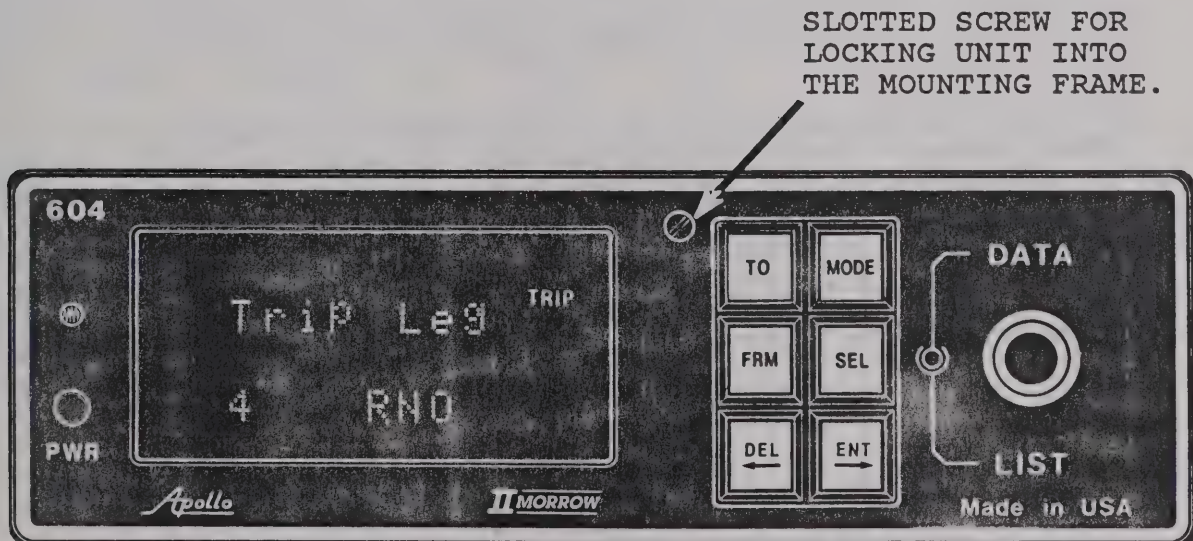


Figure 1

EQUIPMENT DESCRIPTION (cont.)

The APOLLO functions as an area navigation device with position location derived by a LORAN-C receiver on the 100 kHz radio frequency transmitted by land-based stations. The APOLLO enables the operator to utilize point-to-point navigation independently of terrain or altitude.

The APOLLO package consists of the LORAN-C receiver, the mounting frame, and an antenna optimized for LORAN-C reception. The A-16 LORAN-C Whip Antenna is the standard antenna included with the APOLLO Model 604. The A-17 LORAN-C High Speed Blade Antenna and A-23 Bent Whip Antenna are available as options. A long wire antenna may be used with the A-6 preamplifier.

The APOLLO using the optional FC-02 Low Level Flag Adapter or the FC-01 Superflag Adapter can be interfaced with standard low level course deviation indicators (CDIs) and horizontal situation indicators (HSIs) with autopilot interface capability.

Also available is the MD40-10(L) which is a dedicated CDI for APOLLO LORAN-C receivers. The MD40 has integral annunciators for WARN and Waypoint Arrival. The MD40 is available with lighted or unlighted bezels for 14 or 28 VDC systems.

The APOLLO displays your present position in Latitude/Longitude coordinates, bearing and range to the destination or origin, track angle, ground speed in knots, cross track error, and estimated time enroute to your destination.

State-of-the-art, large scale integrated circuitry produces an extremely compact unit: size (H - 2", W - 6.25", D - 11.2"); weight - 3.75 lbs; with a nominal power consumption of 9.5 watts from an input voltage of 6.5 VDC to 48 VDC.

The user-replaceable FLYBRARY data cartridge contains over 5,000 airports, VORs, and NDBs in the continental U.S., Alaska, and Canada. Additional features include: 100 user programmable waypoints, automatic secondary selection, automatic magnetic variation adjustment, nine-leg flight planning with automatic sequencing, and an automatic brightness control for ambient light conditions. User entered memory is kept alive by an internal battery which has a nominal lifecycle of approximately 5 years.

Due to II Morrow's commitment to constantly improve the quality and performance of our equipment all specifications and features are subject to change without notice.

1.3 TECHNICAL SPECIFICATIONS

1.3.1 APOLLO MODEL 604 RECEIVER

1.3.1.1 ELECTRICAL CHARACTERISTICS

POWER

1. Operating Range
6.5 VDC to 48 VDC negative ground
9 Watts nominal
2. Maximum A-Line Power Consumption
0.64 A Nominal at 13.75 VDC
0.33 A Nominal at 28 VDC

INTERFACES

Course Deviation Indicator or Horizontal Situation Indicator with Autopilot Interface

- 1) Course Deviation Loads
1 to 5 1K ohm loads
 ± 150 uA full scale
- 2) Valid Flag Loads
1 1K ohm load
 ± 260 uA for flag out of view
- 3) RS-232 Serial Data Output Interface
Data is asynchronous, 1200 baud
Signal level is 0 to +5 Volts

1.3.1.2 ENVIRONMENTAL QUALIFICATION FORM (RTCA DO-160B)

Model APOLLO 604

Part Number 430-0128-001

CONDITIONS	SECTION/ PARAGRAPH #	DESCRIPTION OF CONDUCTED TESTS
TEMP AND ALTITUDE	4.0	TESTED TO CATEGORIES A1,D1 TESTED PER DO 159 para. 5.1
LOW TEMPERATURE	4.5.1	
HIGH TEMPERATURE	4.5.3	
ALTITUDE	4.6.1	
DECOMPRESSION	4.6.2	
OVERPRESSURE	4.6.3	
TEMPERATURE VARIATION	5.0	TESTED TO CATEGORY B TESTED PER DO 159 para. 5.2
HUMIDITY	6.0	TESTED TO CATEGORY A TESTED PER DO 159 para. 5.3
SHOCK	7.0	TESTED PER DO 159 para. 5.4
OPERATIONAL CRASH SAFTEY	7.2 7.3	6g's 3 SHOCKS PER AXIS IMPULSE AND SUSTAINED SHOCK
VIBRATION	8.0	TESTED TO CATEGORIES P,K,S PARA. 8.3.1 TESTED PER DO 159 para. 5.5
EXPLOSION	9.0	EQUIPMENT IDENTIFIED AS 'X' NO TEST REQUIRED
WATERPROOFNESS	10.0	EQUIPMENT IDENTIFIED AS 'X' NO TEST REQUIRED
FLUIDS SUSCEPTIBILITY	11.0	EQUIPMENT IDENTIFIED AS 'X' NO TEST REQUIRED

ENVIRONMENTAL QUALIFICATION FORM (RTCA DO-160B)

Model APOLLO 604

Part Number 430-0128-001

SAND AND DUST	12.0	EQUIPMENT IDENTIFIED AS 'X' NO TEST REQUIRED
FUNGUS	13.0	EQUIPMENT IDENTIFIED AS 'X' NO TEST REQUIRED
SALT SPRAY	14.0	EQUIPMENT IDENTIFIED AS 'X' NO TEST REQUIRED
MAGNETIC EFFECT	15.0	TESTED TO CATEGORY Z TESTED PER DO 159 para. 5.12
POWER INPUT	16.0	TESTED TO CATEGORIES B,Z TESTED PER DO 159 para. 5.13
VOLTAGE SPIKE CONDUCTED	17.0	TESTED TO CATEGORY A TESTED PER DO 159 para. 5.14
AUDIO FREQUENCY CONDUCTED SUSCEPTIBILITY	18.0	TESTED TO CATEGORY Z TESTED PER DO 159 para. 5.15
INDUCED SIGNAL SUSCEPTIBILITY	19.0	TESTED TO CATEGORY Z TESTED PER DO 159 para. 5.16
RADIO FREQUENCY SUSCEPTIBILITY	20.0	TESTED TO CATEGORY Z TESTED PER DO 159 para. 5.17
RADIO FREQUENCY EMMISSION	21.0	TESTED TO CATEGORY Z TESTED PER DO 159 para 5.18
OTHER TESTS		

1.3.1.3 PHYSICAL CHARACTERISTICS

1. Weight: 3.187 lbs (1.45 kg) includes mounting frame
2. Size: Height - 2.0 inches (5.08 cm)
 Width - 6.25 inches (15.88 cm)
 Depth - 11.2 inches (28.45 cm)
(Depth is from back of front panel to rear of mounting frame)
3. Mounting: Panel
4. FLYBRARY Data Cartridge: 2.4 oz. - Inserts into unit.

1.3.1.4 OPERATIONAL CHARACTERISTICS

Operating Temperature - -20°C to +55°C (-4°F to 131°F)
Operating Humidity - 95% at +50°C (122°F)
Operating Altitude - 50,000 feet (15,240 m)
Track Speed - 400 knots at 0 dB SNR
Time to Track with Triad Selection (GRI 9940)
 2 minutes at 0 dB SNR typical
 3½ minutes at -10 dB SNR typical
Time to Triad Selection with First Position Fix (GRI 9940)
 5 minutes at 0 dB SNR typical
 7 minutes at -10 dB SNR typical
Update Rate of Current Position - 0.8 seconds nominal
Position Repeatability - 0.01 nm typical for primary LORAN-C areas
Range Resolution - 0.1 nm (600 feet)
Cross Track Distance Resolution - 0.01 nm (60 feet)
Cross Track Distance Display Resolution -
 Selectable: in 0.01 nm increments up to 1.00 nm

CDI Display - Enroute ±5.0 nm Full Scale
 Approach ±1.25 nm Full Scale

Memory - Continuous supplied by internal Lithium battery
 Nominal life approximately 5 years

Waypoints (In Lat/Long coordinates):
 FLYBRARY (Federally-designated airports and VORs
 identified by 4 alphanumeric characters) contained
 in a user-replaceable cartridge
 Plus 100 user programmable, PPTO, and PPFR

Notch Filters - 8 Internal (Factory Preset)
Displays - High Intensity Alphanumeric Dot Matrix
Push Buttons - Backlighted

1.3.1.5 RECEIVER SPECIFICATIONS

Dynamic Range - 110 dB
Noise Bandwidth - 23 kHz at receiver output
Sensitivity - 1 uV nominal (atmospheric noise limited)
Minimum Signal-Noise-Ratio (SNR)
 Acquisition - -10 dB
 Track - -30 dB
 Position Display - -30 dB

1.3.2 LORAN-C ANTENNAS

1.3.2.1 A-16 WHIP ANTENNA with integral preamplifier (Standard)

- 1) Environmental Categories
Temperature and Altitude - - - - - D2
Humidity - - - - - A
Vibration - - - - - YJLM
Electromagnetic Compatability - - - - - Z
- 2) Physical Characteristics
Weight: 0.56 lbs (0.25 kg) Height: 17.75 in (45.09 cm)
- 3) Operational Characteristics
Operating Temperature - -55°C to +70°C
Operating Altitude - 50,000 feet (15,240 m)
Speed - 350 kts (402 mph) TAS

1.3.2.2 A-17 BLADE ANTENNA with integral preamplifier (Optional)

- 1) Environmental Categories
Temperature and Altitude - - - - - D2
Humidity - - - - - A
Vibration - - - - - YJLM
Electromagnetic Compatability - - - - - Z
- 2) Physical Characteristics
Weight: 0.70 lbs (0.32 kg) Height: 8.2 in (20.83 cm)
- 3) Operational Characteristics
Operating Temperature - -55°C to +70°C
Operating Altitude - 50,000 feet (15,240 m)
Speed - 521 kts (600 mph) TAS

1.3.2.3 A-23 BENT WHIP ANTENNA with integral preamplifier (Optional)

- 1) Environmental Categories
Temperature and Altitude - - - - - D2
Humidity - - - - - A
Vibration - - - - - YJLM
Salt Spray - - - - - S
Electromagnetic Compatability - - - - - Z
- 2) Physical Characteristics
Weight: 0.413 lbs (0.187 kg)
Size: Height - 8.25 inches (20.96 cm)
- 3) Operational Characteristics
Operating Temperature - -55°C to +70°C
Operating Altitude - 50,000 feet (15,240 m)
- 4) Speed - 350 kts (402 mph) TAS

1.3.3 A-6 PREAMPLIFIER for use with Long Wire Antennas (Optional)

1) Environmental Categories

Temperature and Altitude	- - - - -	A1, C2, D1
Humidity	- - - - -	A
Vibration	- - - - -	YJLM
Electromagnetic Compatability	- - - - -	Z

2) Physical Characteristics

Weight:	0.172 lbs	(0.078 kg)
Size: Height	- 0.75 inches	(1.95 cm)
Width	- 1.60 inches	(4.06 cm)
Depth	- 4.50 inches	(11.4 cm)

3) Operational Characteristics

Operating Temperature	-	-55°C to +70°C
Operating Altitude	-	50,000 feet (15,240 m)

Due to II Morrow's commitment to constantly improve the quality and performance of our equipment, all specifications and features are subject to change without notice.

1.4 UNITS AND ACCESSORIES

1.4.1 Standard Units and Accessories Supplied

The APOLLO Model 604 Navigation System package consists of the APOLLO Model 604 LORAN-C navigation receiver, the mounting frame, installation kit, and the choice of the A-16 Whip antenna, optional A-17 High Speed Blade antenna, or optional A-23 Bent Whip antenna. The A-16 Whip antenna is the standard antenna to accompany the APOLLO Model 604.

1.4.1.1 Units Supplied

II Morrow P/N	Description	Quantity
430-0128-001 (or later version) and	APOLLO Model 604	1
430-0035-000 and	A-16 Whip Antenna	1
420-0003 (optional)	604 FLYBRARY Cartridge	1

1.4.1.2 Accessories Supplied

INSTALLATION KIT

II Morrow P/N	Description	Quantity
162-1008	Panel Plug Coax Delta	1
162-1009	BNC Connector Taper Grip Cable	1
162-3001	14-Pin Panel Receptacle	1
172-1501	Fuse - 5 Amp Fast Blow	1
201-0009	Pneumatic Fitting Sleeve	1
202-0001	Cable Tie	2
202-0005	Tie Mount	2
221-0304	3-48 x 1/4 Phillips Screws	2
221-0400	Screw with Lockwasher (4-40 x 1/4)	2
221-0406	Machine Screw (4-40 x 3/8)	2
229-0608	Button Head Hex Screw (6-32 x 1/2)	6
240-0310	#3 Internal Lockwashers	2
240-0410	#4 Internal Lockwashers	2
310-2030	Connector Cover	1
310-2032	Shoulder Bushing	2
418-0020	Mounting Frame Assembly	1
500-2024	Coaxial Cable 15 feet (RG58U Belden P/N 88240)	1
560-0038	604 Operation Manual Rev. 0, or later approved revision	1
560-9002	Binder 8-1/2" x 5-1/2" 3-Ring	1
561-0009	Aviation Warranty Card	1
560-0037	Installation Manual	1

1.4.2 ACCESSORIES

Antennas other than the ones supplied with an APOLLO LORAN-C receiver package may be purchased as an option by arrangement with the retailer or the factory.

1.4.2.1 ANTENNAS and PREAMPLIFIERS

Antennas optimized for use with APOLLO LORAN-C receivers are available from II Morrow Inc. For recommendations about special applications you should contact the factory.

430-0035-000	A-16 Whip Antenna with integral preamplifier
430-0038-000 or 430-0038-001	A-17 High Speed Blade Antenna with integral preamplifier
430-0066-000	A-23 Bent Whip Antenna with integral preamplifier
430-0013-000	A-6 Preamplifier with cables for use with a long wire antenna (such as a Dayton-Granger 15620)

1.4.2.2 FC-02 LOW LEVEL FLAG ADAPTER

The optional FC-02 Low Level Flag Adapter is used to interface the APOLLO with CDIs having separate movements for the TO/FROM flags and the NAV Flag.

430-0131-000	FC-02 Low Level Flag Adapter
--------------	------------------------------

1.4.2.3 FC-01 SUPERFLAG ADAPTER

The FC-01 Superflag Adapter is used to interface the APOLLO with CDIs having separate movements for the TO/FROM flags and the NAV Flag or where a superflag input is required for an autopilot.

430-0125-000	FC-01 Superflag Adapter
--------------	-------------------------

1.4.2.4 LORAN-C COURSE DEVIATION INDICATORS

Two models of Course Deviation Indicators are provided which have been specially designed for use with LORAN-C navigation systems: the MD40-10 and the MD40-10L. The MD40-10L has the provision for a lighted face while the MD-40 does not. Both CDIs have internal annunciators for LORAN WARN (WARN), LORAN VFR (VFR), WAYPOINT ALERT (WPT), and APPROACH (APR).

428-2000	MD40-10 Course Deviation Indicator
428-2000L	MD40-10L Course Deviation Indicator

1.4.2.5 A-6 Preamplifier

The A-6 LORAN-C Preamplifier is used to interface long wire or antennas not manufactured by II Morrow, Inc. The A-6 is designed for use with non-loaded antennas without any matching devices or other preamplifiers.

430-0013-000

A-6 Preamplifier

1.5 FAA APPROVAL OF AREA NAVIGATION INSTALLATION

For compliance with certified installation of the the APOLLO Model 604, the appropriate placard (LORAN-C) must be displayed near the receiver unless otherwise specified. The additional placards provided are to be used for labeling a CDI, if connected, and for the indicators. The decal that MUST be used is: "LORAN SYSTEM TO BE USED FOR VFR ONLY".

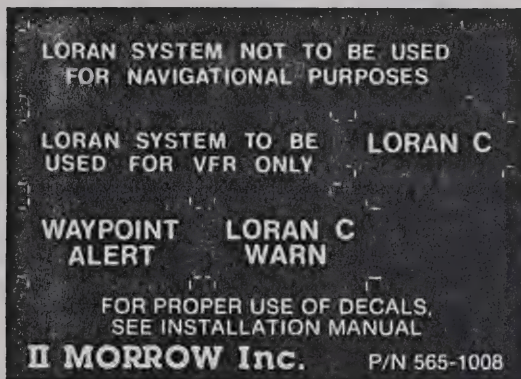


Figure 2

1.6 EQUIPMENT LIMITATIONS

1.6.1 APOLLO Model 604 LORAN-C Receiver

The APOLLO Model 604 receiver is limited to operating on the chains and secondaries specified in the table below.

TABLE OF LORAN-C CHAINS

GRI	NAME	SECONDARY DESIGNATOR	CODING DELAY
4990	CENTRAL PACIFIC	XRAY YANKEE	11,000 29,000
5930	CANADIAN EAST COAST	XRAY YANKEE ZULU	11,000 25,000 38,000
5970	COMMANDO LION (KOREA)	WHISKY XRAY ZULU	11,000 31,000 42,000
5990	CANADIAN WEST COAST	XRAY YANKEE ZULU	11,000 27,000 41,000
7170	SAUDI ARABIA (SOUTH)	WHISKY XRAY YANKEE ZULU	11,000 26,000 39,000 52,000
7930	LABRADOR SEA	WHISKY XRAY	11,000 26,000
7960	GULF OF ALASKA	XRAY YANKEE	11,000 26,000
7970	NORWEGIAN SEA	XRAY WHISKY YANKEE ZULU	11,000 26,000 46,000 60,000
7980	SOUTHEAST U.S.	WHISKY XRAY YANKEE ZULU	11,000 22,000 43,000 59,000

TABLE OF LORAN-C CHAINS (cont.)

GRI	NAME	SECONDARY DESIGNATOR	CODING DELAY
7990	MEDITERRANEAN	XRAY YANKEE ZULU	11,000 29,000 47,000
8940	WESTERN EUROPE (FRANCE)	WHISKY XRAY	12,000 30,000
8970	GREAT LAKES	WHISKY XRAY YANKEE	11,000 28,000 44,000
8990	NORTH SAUDI ARABIA	VICTOR WHISKY XRAY YANKEE ZULU	11,000 25,000 40,000 56,000 69,000
9940	WEST COAST	WHISKY XRAY YANKEE	11,000 27,000 40,000
9960	NORTHEAST U.S.	WHISKY XRAY YANKEE ZULU	11,000 25,000 39,000 54,000
9970	NORTHWEST PACIFIC	WHISKY XRAY YANKEE ZULU	11,000 30,000 55,000 75,000
9980	ICELANDIC	WHISKY XRAY	11,000 30,000
9990	NORTH PACIFIC	XRAY WHISKY ZULU	11,000 29,000 43,000

1.6.2 ACQUISITION - The APOLLO Model 604 will acquire and track the Master and all available Secondaries of a specified chain and operate as specified.

1.6.3 MAXIMUM TRACK VELOCITY - The maximum track velocity is 400 knots at 0 dB SNR.

1.7 RS-232 SERIAL DATA OUTPUT SPECIFICATIONS

The APOLLO Model 604 provides RS-232 serial data output for use in interfacing with computers possessing RS-232 data input capabilities. Data supplied will provide information on signal quality, position, and other displayed receiver functions. The specifications for the APOLLO Serial Data Output are described below.

Electrical Format:

RS-232C
Logic 1 = 0 Volts
Logic 0 = +5 Volts

Data Format:

Asynchronous, 1200 Baud
1 Start Bit
7 Data Bits
1 Parity Bit - Odd
1 Stop Bit

This data format conforms to Standard UART Data Format (INTEL 8251 and MOTOROLA MC6850).

The data is formatted into various groups representing receiver functions (i.e. Lat/Lon, SNR, and Signal Tracking status). Each data group is formatted by a control character followed by the data. Data is generally transmitted in ASCII format. A description of the data groups and their specifications is given below.

LATITUDE/LONGITUDE DATA GROUP

Character	Definition	Value
1	Start Character	'#'
2	Lat/Long Char.	'L'
3	Space	20H
4	Hemisphere	'N'
5	Lat. Deg. MSD	3_
6	Lat. Deg. LSD	3_
7	Lat. Min. MSD	3_
8	Lat. Min.	3_
9	Lat. Min.	3_
10	Lat. Min. LSD	3_
11	Space	20H
12	Hemisphere	'W'
13	Lon. Deg. MSD	3_
14	Lon. Deg.	3_
15	Lon. Deg. LSD	3_
16	Lon. Min. MSD	3_
17	Lon. Min.	3_
18	Lon. Min.	3_
19	Lon. Min. LSD	3_
20	<CR>	0DH

SNR VALUES DATA GROUP

Character	Definition	Value
1	Start Character	'#'
2	SNR Character	'S'
3	Space	20H
4	Master Identifier	'M'
5	Master SNR MSD	3_
6	Master SNR	3_
7	Master SNR LSD	3_
8	Space	20H
9	Slave Identifier	'A'
10	Slave SNR MSD	3_
11	Slave SNR	3_
12	Slave SNR LSD	3_
13	Space	20H
14	Slave Identifier	'B'
15	Slave SNR MSD	3_
16	Slave SNR	3_
17	Slave SNR LSD	3_
18	<CR>	0DH

NOTE: After the APOLLO Model 604 has settled, the 'A' and 'B' slave identifiers will be replaced by the appropriate letter for the station selected in the current triad (W, X, Y, or Z).

TRIAD SELECTION STATUS DATA GROUP

The bits denoting the stations (M,W,X,Y,Z) are set according to the tracking status of the selected triad. If the MWX triad is used, then only the M,W,X status bits are defined. A "0" bit value implies tracking status. A "1" bit value implies non-tracking status.

Character	Definition	Value
1	Start Character	'#'
2	Status Character	'C'
3	Space	20H
4	Status Word	(D7: 0 (D6: 0 (D5: 0 (D4: M (D3: W (D2: X (D1: Y (D0: Z
5	<CR>	0DH

NAVIGATION MODE VALUES DATA GROUP (A)

Character	Definition	Value
1	Start Character	'#'
2	Identifying Character	'N'
3	Identifying Character	'A'
4	Space	20H
5	Bearing Identifier	'B'
6	Bearing MSD	3_
7	Bearing	3_
8	Bearing LSD	3_
9	Space	20H
10	Range Identifier	'R'
11	Range MSD	3_
12	Range	3_
13	Range	3_
14	Range	3_
15	Decimal Point	'.'
16	Range LSD	3_
17	Space	20H
18	Bearing (FROM) Identifier	'B'
19	Bearing (FROM) Identifier	'F'
20	Bearing (FROM) MSD	3_
21	Bearing (FROM)	3_
22	Bearing (FROM) LSD	3_
23	Space	20H
24	Range (FROM) Identifier	'R'
25	Range (FROM) Identifier	'F'
26	Range (FROM) MSD	3_
27	Range (FROM)	3_
28	Range (FROM)	3_
29	Range (FROM)	3_
30	Decimal Point	'.'
31	Range (FROM) LSD	3_
32	<CR>	0DH

NAVIGATION MODE VALUES DATA GROUP (B)

Character	Definition	Value
1	Start Character	'#'
2	Identifying Character	'N'
3	Identifying Character	'B'
4	Space	20H
5	DTK Identifier	'C'
6	DTK MSD	3_
7	DTK	3_
8	DTK LSD	3_
9	Space	20H
10	Distance Identifier	'D'
11	Distance MSD	3_
12	Distance	3_
13	Distance	3_
14	Distance	3_
15	Decimal Point	'.'
16	Distance	3_
17	<CR>	0DH

NAVIGATION MODE VALUES DATA GROUP (C)

Character	Definition	Value
1	Start Character	'#'
2	Identifying Character	'N'
3	Identifying Character	'C'
4	Space	20H
5	TRK Identifier	'T'
6	TRK MSD	3_
7	TRK	3_
8	TRK LSD	3_
9	Space	20H
10	GS Identifier	'S'
11	GS MSD	3_
12	GS	3_
13	GS	3_
14	Decimal Point	'.'
15	GS LSD	3_
16	Space	20H
17	ETE Identifier	'E'
18	ETE Identifier	'T'
19	ETE MSD	3_
20	Colon	':'
21	ETE	3_
22	ETE LSD	3_
23	Space	20H
24	XTD Identifier	'X'
25	XTD Identifier	'T'
26	XTD Sign	'+' or '-'
27	XTD MSD	3_
28	XTD	3_
29	Decimal Point	'.'
30	XTD	3_
31	XTD LSD	3_
32	<CR>	0DH

NOTE: When Ground Speed is less than 1.0 knot, the TRK and ETE digits will be replaced by dashes ('-') and the Ground Speed digits will be all zeros.

SECTION II
INSTALLATION PROCEDURES

2.1 GENERAL INFORMATION

This section presents installation and wiring information for the APOLLO Model 604 LORAN-C Navigation System.

2.1.1 Standard Practices

At all times, installation procedures should follow good aviation installation practices as per AC 43.13 Ch. 11 and AC 20-121.

2.1.2 Installation Limitations

- 1) The antenna placement is possible on both the top or bottom of the aircraft. Preferred placement for best performance is top mounting. If bottom mounted, see sec. 2.3.2
- 2) The LORAN-C antenna must be at least 6 inches from a transmitting antenna that emits 25 W or less, and at least 2 feet away from a high power radio transmitting antenna.

- 3) The antenna must be of a type approved by II Morrow Inc., such as:

Whip: A-16 P/N 430-0035-000 (Standard)
Bent Whip: A-23 P/N 430-0066-000 (Optional)
Blade: A-17 P/N 430-0038-000 or 430-0038-001 (Optional)

Long Wire Antenna

II Morrow Inc. P/N 590-1004
Dayton-Granger P/N 15620

An equivalent coated long wire antenna may be used.

- 4) In selecting an antenna mounting site, consider locations that meet the following criteria: low electrical noise, unobstructed reception, proper grounding to the aircraft frame, and adequate metal surface area for a good ground plane (this may need to be added by the installer).
- 5) A CDI or HSI display units with internal conversions may not be used. CDIs that have separate movements for the TO/FROM and the NAV VALID flags (such as the Collins IND350A) must use the FC-02 Low Level Flag Adapter P/N 430-0131-000 or the FC-01 Superflag Adapter P/N 430-0125-000.
- 6) Autopilots requiring a superflag input must use the II Morrow FC-01 Superflag Adapter P/N 430-0125-000.
- 7) Circuit breakers or fuses shall not exceed a maximum current rating of 5.0 Amperes. Fuses, when used, shall be of the slow-blow type. Circuit breakers, when used, shall be resettable. Circuit breakers should meet MIL STD MS-25244-5, MS-22073-5, or MS-26574 (such as Klixon MS-26754-5, OR 7274-2-5).
- 8) Switches should meet MIL-1-45208A. Relays should meet MIL-STD-202B.

2.1.3 Static Precautions

LORAN-C installations are sensitive to precipitation static. Precipitation static may cause interference, or even loss of the signal, in severe weather conditions (dust, ice, rain, or snow). Engine exhaust may also cause precipitation static.

Special attention is required to protect the aircraft from precipitation static when navigation in inclement weather is expected.

The fuselage of the aircraft should have ground bonding straps between all sections and control surfaces to provide a common ground throughout the aircraft. All equipment should be well grounded to the aircraft frame. De-icing boots and doors should be bonded to the airframe. When making ground connections, use fine sandpaper to remove all paint and protective coatings. Use appropriate compounds for surface preparation and finishing of grounding points. Locate the antenna as far to the rear as possible on the aircraft.

Install static discharge wicks in the appropriate locations and according to the wick manufacturer's specifications. Be careful to insure that the wicks are well bonded and have them periodically inspected for damage. Use a good quality static discharge wick. Frayed tip wicks are not recommended.

The windshield of an aircraft often provides an additional source of electrical interference caused by frictional charging. Bonding the windshield to the airframe will reduce this source of interference.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Exercise care when unpacking the equipment. Visually inspect the unit for any evidence of damage incurred during shipment. It is advised to retain the shipping container and packaging material in case reshipment becomes necessary.

NOTE: If a claim of damage needs to be filed, save the shipping container to substantiate the claim. The claim should be appropriately filed with the shipping company.

2.3 EQUIPMENT INSTALLATION

This section will detail the installation of the antenna, receiver, preamplifier, indicators, and wiring hookups. Read the entire section before beginning the installation process. Perform the system checkout procedure before sealing the work area in case problems occur. Additional information is provided on bottom mounting an antenna, air cooling, and helicopter installation.

2.3.1 Antenna Installation

II Morrow offers several antenna configurations for use with APOLLO Model 604 units. Antennas produced by II Morrow Inc. are optimized for use with the APOLLO LORAN-C receivers.

Antennas for the APOLLO Model 604 may either be top or bottom mounted. Top mounting is the recommended position, however if bottom mounting is required instructions are provided for the necessary internal adjustments in the APOLLO Model 604 (see section 2.3.2).

Proper grounding is one of the most important factors in LORAN-C antenna installation. Optimum grounding and antenna performance may be obtained with direct metal-to-metal contact between the antenna base and aircraft skin (or installed ground plane). Paint should be removed beneath the antenna base and the surface should be lightly sanded in accordance to AC 43.13. In some cases, a heavy gauge wire between the antenna base and the aircraft may be required.

Optimum antenna performance requires an adequate metal surface below the antenna mount to create a ground plane. If the selected antenna position does not provide a sufficient ground plane, the installer will need to create one by using a wire mesh, wire radials, or metal plating. The ground plane, installed or otherwise, must be connected to the aircraft chassis ground.

2.3.1.1 II Morrow LORAN-C Antennas

II Morrow Inc. LORAN-C antennas are vertically polarized with the preamplifier internally mounted. The antennas are connected directly to the APOLLO Model 604. The connecting cable should be RG58A/U or RG58/U. The length is not critical (length should not exceed 100 ft).

The A-16 whip antenna is the standard antenna with the APOLLO Model 604. The maximum recommended speed for the A-16 whip antenna is 350 knots (402 mph) TAS.

The A-17 blade antenna is an optional antenna with the APOLLO Model 604. The maximum recommended speed for the A-17 blade antenna P/N 430-0038-000 is 521 knots (600 mph) TAS. The maximum recommended speed for the A-17 blade antenna P/N 430-0038-001 is 600 knots (690 mph or 0.9 mach) TAS.

The A-23 bent whip antenna is an optional antenna with the APOLLO Model 604. The maximum recommended speed for the A-23 bent whip antenna is 350 knots (402 mph) TAS.

Never wax or paint an antenna. Coating an antenna with a foreign substance may severely reduce the received signal. Some paints may not be removed without destroying the P-Static coating of the antenna.

2.3.1.2 Long Wire or Other Antennas (Optional)

Long wire, or any antenna other than the A-16 or A-17, requires the use of the A-6 preamplifier. The A-6 preamplifier is designed to operate with a nonloaded antenna without any matching devices. The A-6 antenna preamplifier must be located within 6 inches of the antenna. The connecting coax cable may be RG58U or RG58A/U.

The Dayton-Granger 15620 or a coated long wire ADF sense antenna may be used. The long wire minimum length should be four feet or more to provide the best results.

The long wire antenna should be secured to the tip of the stabilizer where possible. Follow the manufacturer's instructions when installing the antenna.

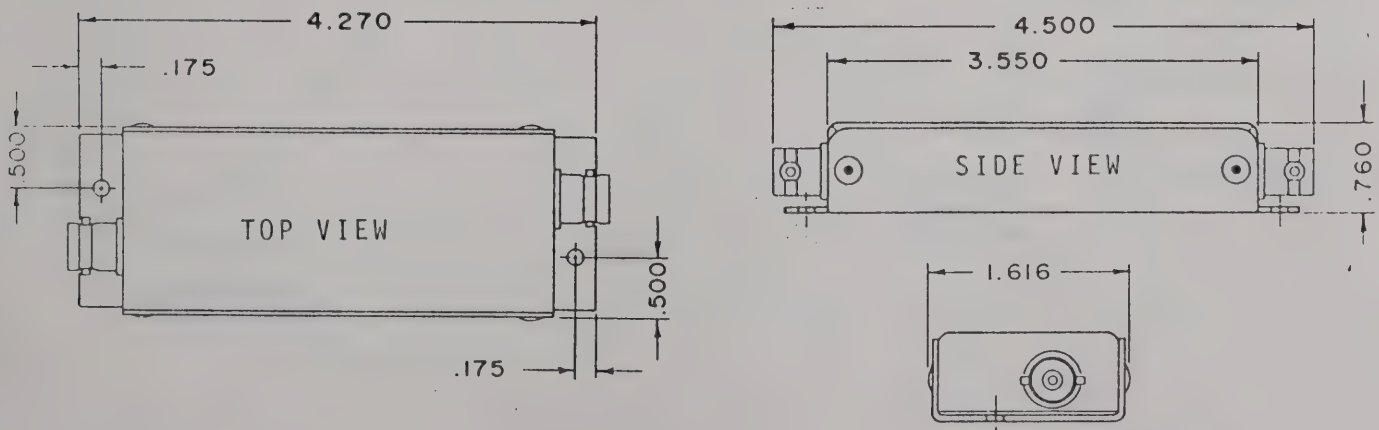
An antenna may be an integral component of an aircraft's structure, as in plastic aircraft. A good ground plane must also be present or installed to guarantee optimum performance. A ground plane may be constructed by running wire the length of the airframe, or by implanting a wire mesh, and then using this as the system ground. Contact the aircraft's designer or manufacturer for the best antenna location.

2.3.1.3 A-6 Preamplifier Connections

The A-6 preamplifier is required when antennas other than the A-16 or A-17 are selected for use. When used, the A-6 preamplifier is provided with two 6 inch coax cables (RG58A/U or RG58U). One 6 inch cable provides for BNC to BNC connector coupling. The other cable connects BNC to spadelugs. Connect as appropriate in the individual application. The preamplifier should be mounted at least two feet away from a HF or VHF radio transmitting antenna.

NOTE: The A-6 antenna preamplifier must be located within 6 inches of the antenna. Do NOT lengthen the provided coax cables.

The preamplifier dimensions are illustrated in the following diagram.



WHIP ANTENNA

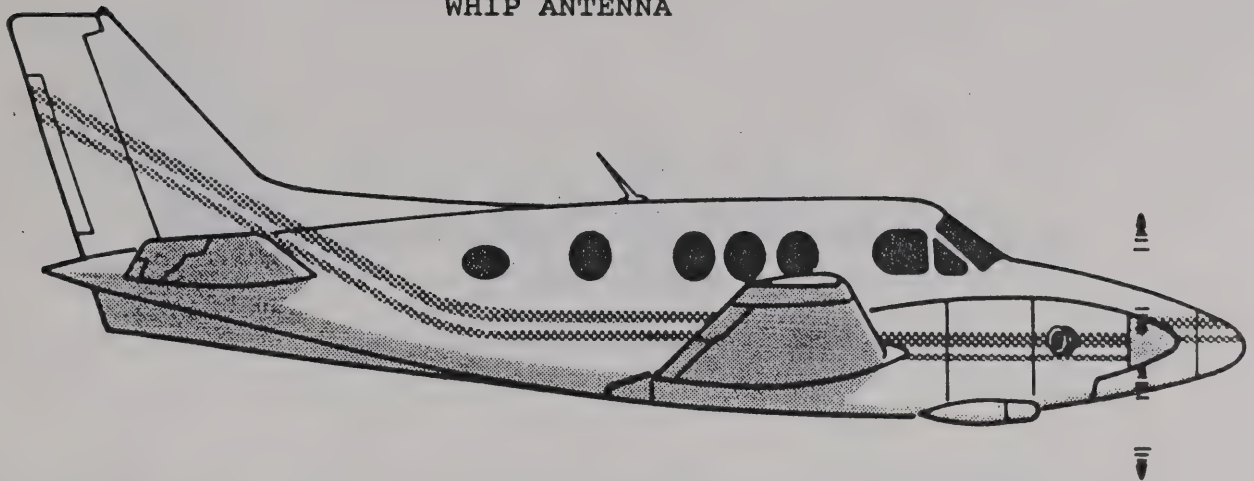
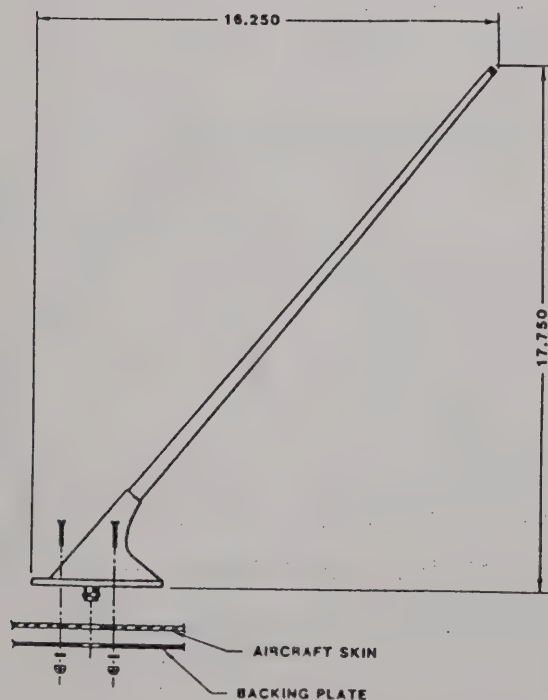


Figure 3

Locate the A-16 at least 6 inches away from a transmitting antenna that emits 25 W or less, and two feet away from a high power transmitting antenna. Do not use the A-6 preamplifier with the A-16 antenna.

NOTE: The antenna should be placed as high as possible for optimum performance.

A-16 WHIP ANTENNA and MOUNT



A-16 MOUNTING TEMPLATE

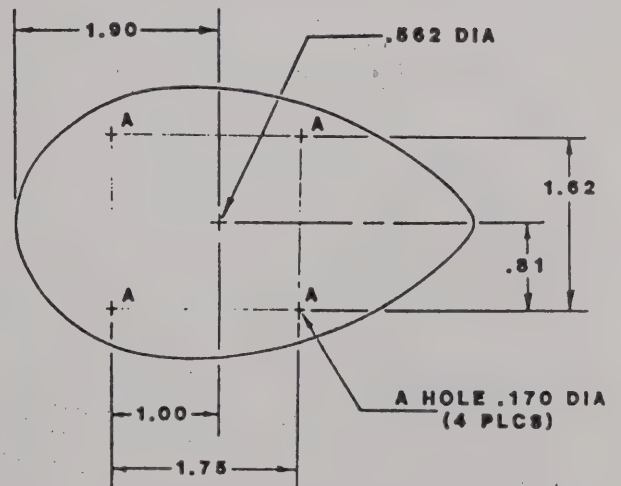


Figure 4

BENT WHIP ANTENNA

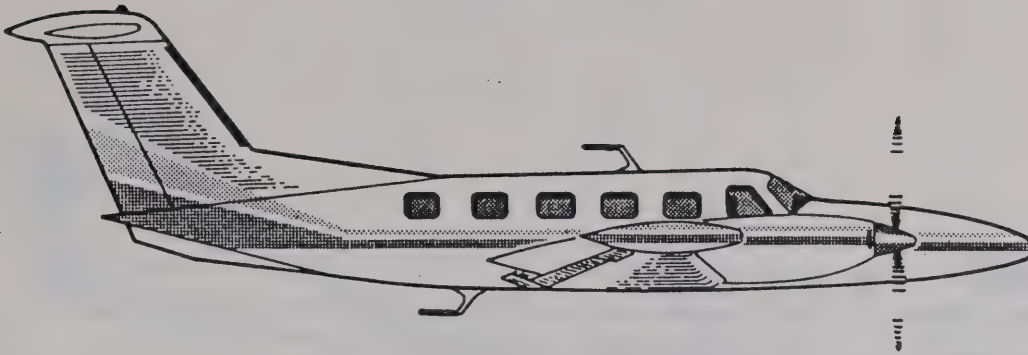


Figure 5

Locate the A-23 at least 6 inches away from a transmitting antenna that emits 25 W or less, and two feet away from a high power transmitting antenna. Do not use the A-6 preamplifier with the A-23 antenna.

NOTE: The antenna should be placed as high as possible for optimum performance.

A-23 WHIP ANTENNA and MOUNT

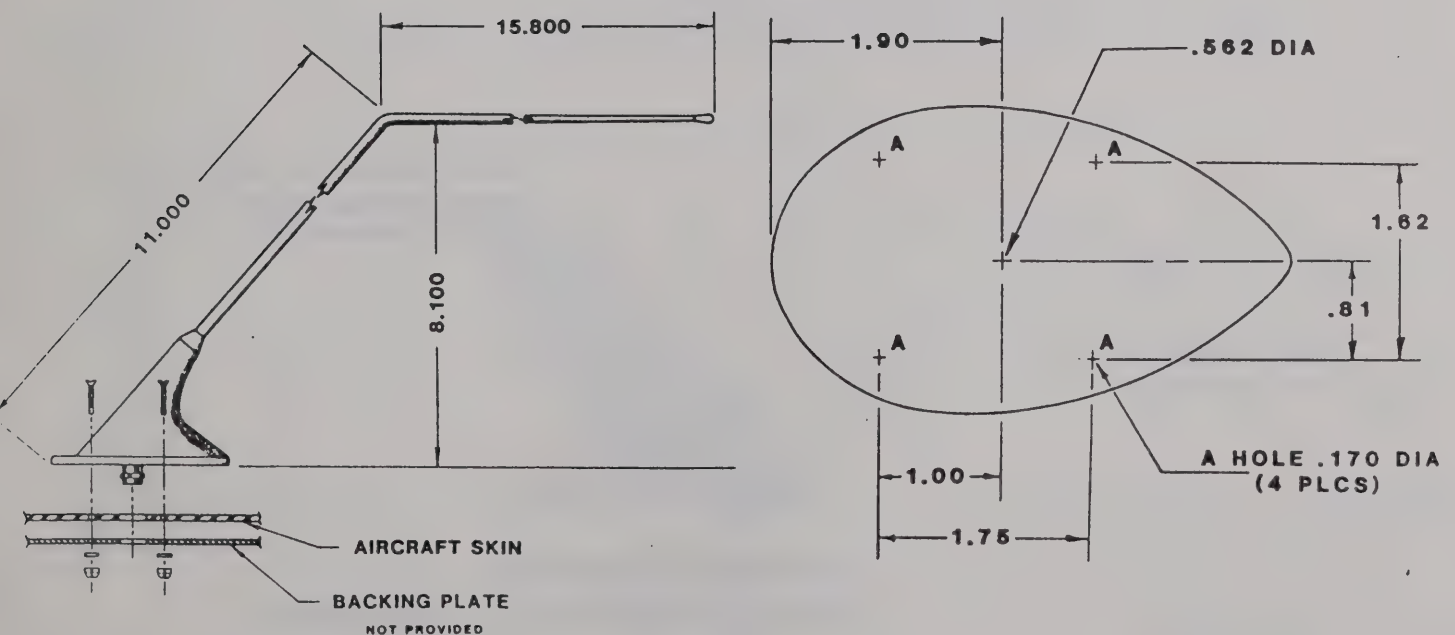


Figure 6

BLADE ANTENNA

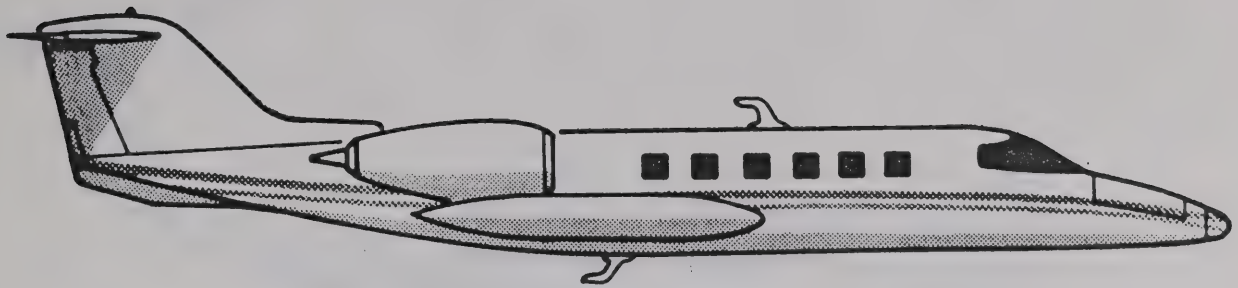


Figure 7

Locate the A-17 at least 6 inches away from a transmitting antenna that emits 25 W or less, and at least two feet away from a high power transmitting antenna. Do not use the A-6 preamplifier with the A-17 antenna. The supplied coax cable which connects between the APOLLO LORAN-C receiver and the antenna may be changed in length.

NOTE: The antenna should be placed as clear as possible from obstructions for optimum performance. Bottom mounting is permitted (see section 2.3.2).

A-17 BLADE ANTENNA and MOUNT

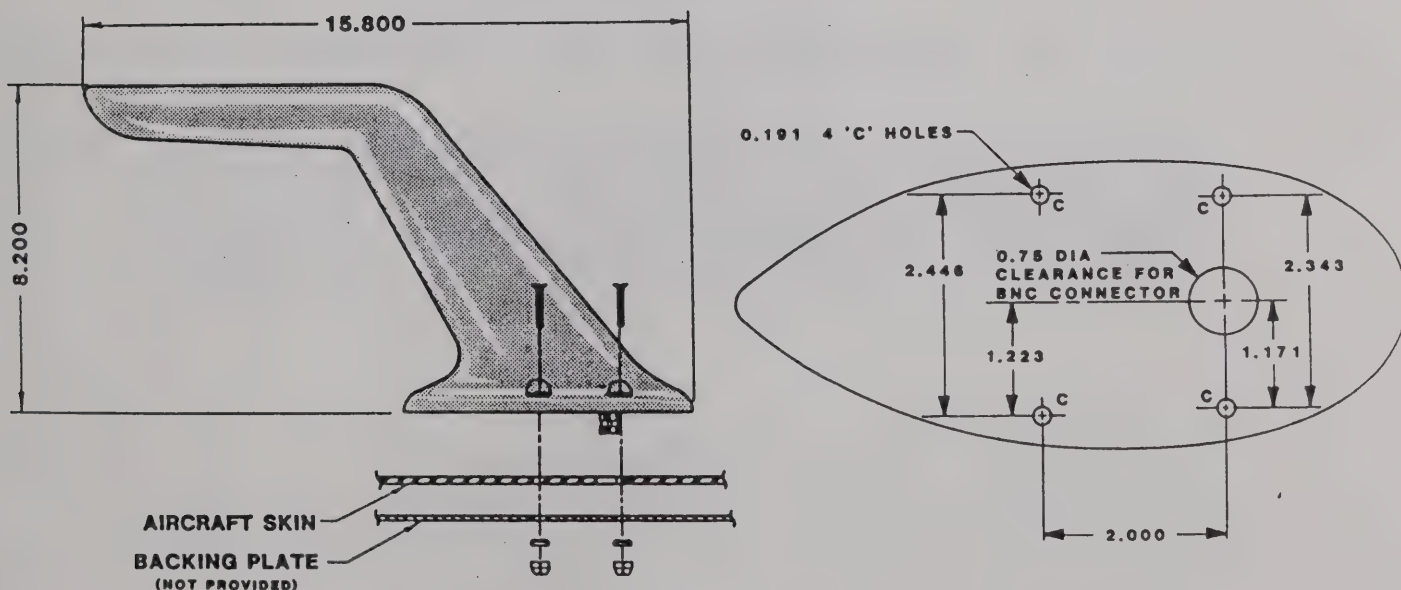


Figure 8

LONG WIRE ANTENNA

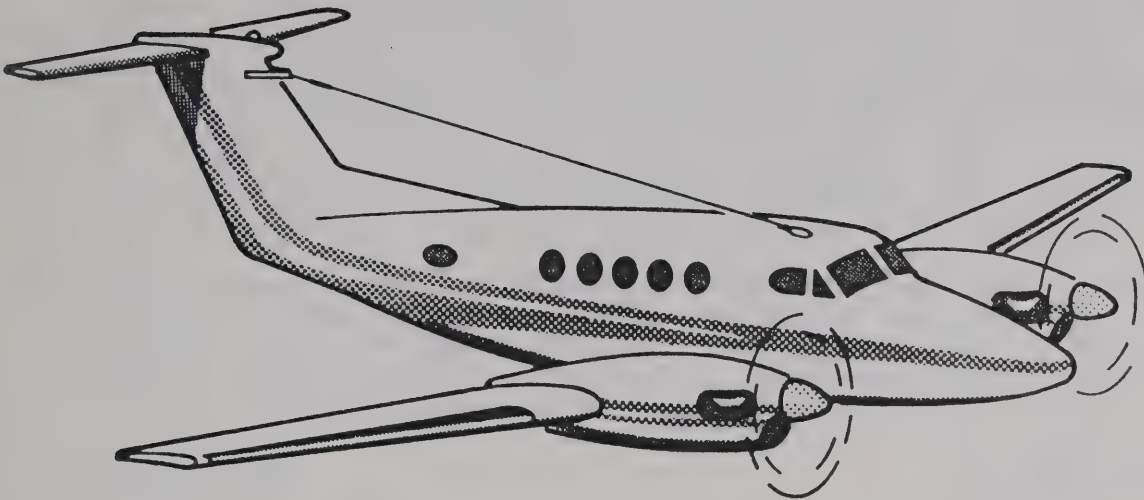


Figure 9

Use the Dayton-Granger 15620 long wire antenna or equivalent.

LORAN-C long wire antenna may be mounted next to the ADF long wire antenna. An existing ADF long wire antenna may be used as the LORAN-C long wire when the LORAN-C installation replaces an ADF system.

The long wire antenna should be four ft. or longer.

NOTE: The A-6 preamplifier is required when using a long wire or integral antenna. The supplied coax cable to connect between the preamplifier and the antenna is 6" long and MUST NOT be lengthened. The supplied coax cable which connects between the APOLLO LORAN-C receiver and the preamplifier may be changed in length.

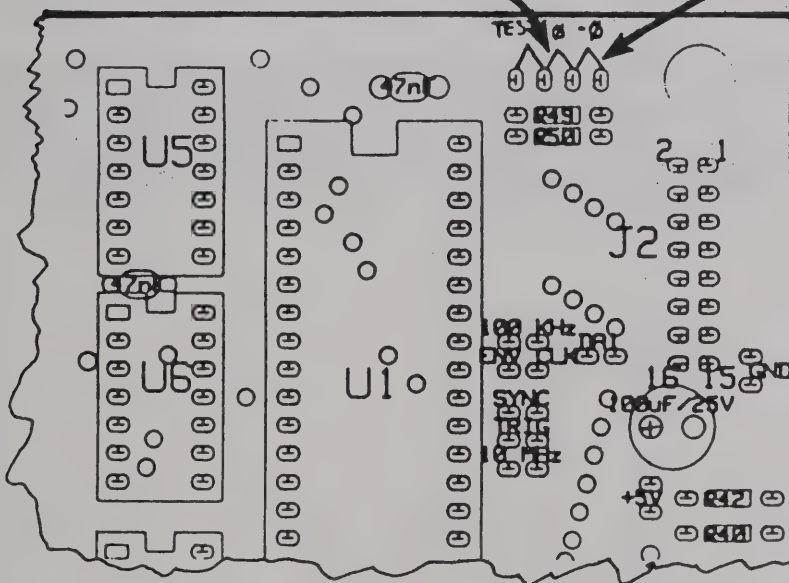
2.3.2 Bottom Mounted Antenna Placement

While the best location for antenna installation is on the top of the aircraft, it is possible to mount the antenna on the bottom. Phase reversal of the LORAN-C signal occurs when the antenna is bottom mounted. The APOLLO Model 604 has an internal jumper wire connection on the Digital Board to correct for this condition. The diagram below shows the position of the jumper connection (see Figure 10). The jumper should be in the "+Ø" position for a top mounted antenna and should be in the "-Ø" position for a bottom mounted antenna. The APOLLO comes from the factory with the jumper in the "+Ø" position.

The Digital Board is located beneath the top cover of the APOLLO Model 604. Access is gained by removing the five phillips screws attaching the top cover, two on each side and one on the rear. Phase jumper is located in the front right corner of the Digital Board as you are facing the front of the unit.

TOP MOUNTED
ANTENNA

BOTTOM MOUNTED
ANTENNA



This corner of the Digital Board is directly behind the front panel rotary switches.

Figure 10

2.3.3 APOLLO Model 604 Receiver Installation

The APOLLO Model 604 LORAN-C Receiver is designed to be panel mounted with the enclosed accessories and hardware. The APOLLO Model 604 is best located in a position where the pilot has a clear view of the display during instrument scans.

The APOLLO Model 604 is very sensitive and uses relatively low signal levels. The APOLLO Model 604 should not be located near motors, or any other item which creates high levels of electrical noise.

The installation procedure described is illustrated with several diagrams. The recommended installation procedure begins with the determination of required clearances for the receiver in the panel. Figure 11 combines a view of the front panel with dimensions and a view of the top and side views with dimensions. The depth of the receiver from the front panel to the rear connectors is 11.2 inches (28.45 cm). Allow adequate depth in the mounting area to prevent sharp bends in any cable or wire. Leave a clearance of 1/4" between all components of the avionics stack for cooling, if possible. See section 2.3.6 on air cooling.

A diagram (Figure 12) of the Installation Assembly for the mounting frame illustrates the electrical and mechanical connections to the unit.

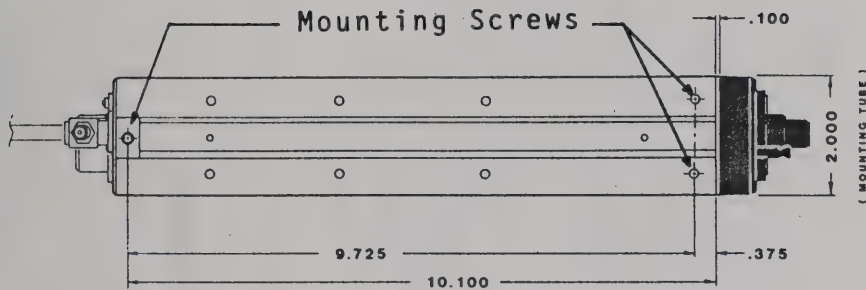
Install the mounting frame into the panel when the mounting frame connections are completed. Carefully insert the APOLLO Model 604 into the mounting frame, noting that the pin connectors match. Thread the slotted screw into the receiver and tighten the screw to securely lock the receiver into the panel.

Apollo

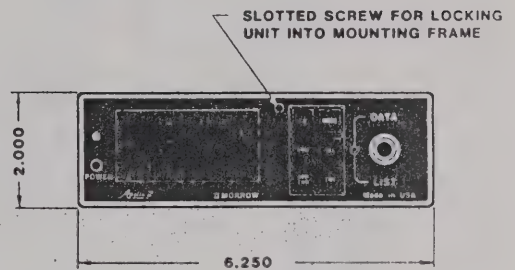
MODEL 604

FRONT PANEL, TOP, and SIDE VIEWS

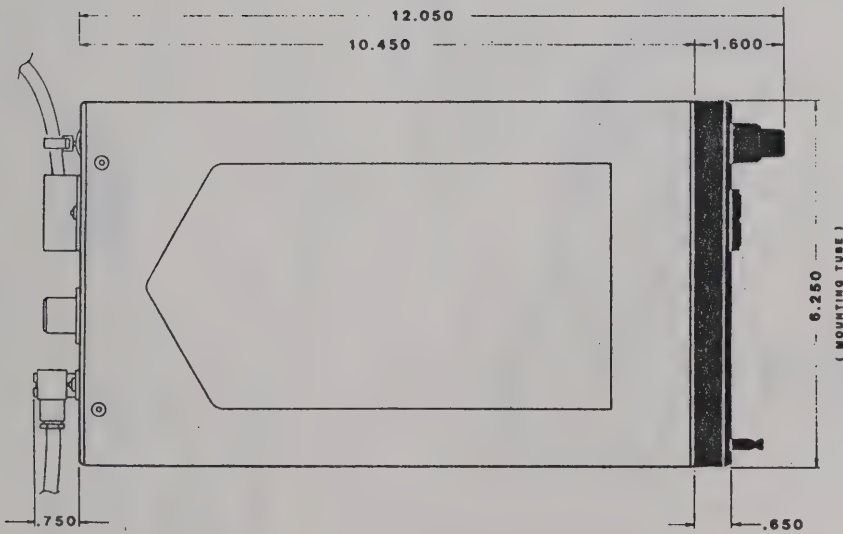
SIDE VIEW



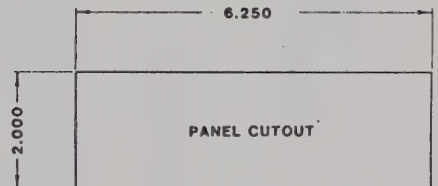
FRONT PANEL



TOP VIEW



PANEL CUTOUT



NOTE: DIMENSIONS PROVIDED ARE OF THE UNIT'S MOUNTING TUBE

Figure 11

REV	DATE	REVISION	BY	CHK
1	10/15/77	REVISED	EL	
2	10/15/77	REVISED	EL	
3	10/15/77	REVISED	EL	

14 PIN PANEL RECEPTICAL
162-3001

3-48X1/4 PHILLIPS SCREWS
221-0304

TIE MOUNT
202-0005

NO. 3 INT. LOCKWASHERS
240-0310

CABLE TIE
202-0001

MOUNTING FRAME
418-0020

CONNECTOR COVER
310-2030

AIR INTAKE FITTING
SLEEVE
201-0000

TIE MOUNT
202-0005

4-40X1/4 SCREWS WITH
LOCK WASHERS
221-0400

PANEL PLUG
162-1008

6-32X1/2 BUTTON HEAD HEX SCREWS
220-0608 (6 PLACES)

REQUIRES 5/64 HEX DRIVER

SHOULDER BUSHING
310-2032

RG58A/U BELDEN NO. 8259
OR EQUIVALENT
(15 FT. SUPPLIED 500-2008)

4-40X3/8 MACHINE
SCREWS
221-0408

NO. 4 LOCK WASHERS
240-0410

II MORROW Inc. P.O. BOX 13549 SALEM, OR USA 97308		DRAWN BY: E.O. REVISED:
SCALE: 1:1 DATE: 5-7-84	APPROVED BY: <i>Dr. S. H. H.</i>	
INSTALLATION ASSEMBLY		
APOLLO MODEL 604		PART NO. 10000 REV. 10000

II-12

Figure 12

2.3.4 Wiring Instructions

Determine the length and routing of all cables before actual installation. When installing cables, avoid any sharp bends or placement near the aircraft control, power, DME, transponder, or radio communications cables. Wire must meet MIL-W-22759 or MIL-W-5086. Tefzel or Teflon insulated is the preferred type of wire.

The wiring necessary for the installation of the APOLLO Model 604 includes the rear panel electrical connections and antenna/preamplifier cable placement. Preparation of the antenna and/or preamplifier cables is also necessary. The panel receptacle must be assembled and may be wired before or after being installed into the mounting frame.

A wiring diagram (Figure 21) shows the electrical connections. The recommended connecting wire size is 20 AWG. A pin assignment list is shown in Figure 20. Panel receptacle wiring is shown in Figure 19.

Measure the length of coax cable needed to connect the antenna (with integral preamplifier) to the receiver unit. 15 feet of coax cable (RG58U II Morrow P/N 500-2024) are provided. Begin to prepare the required length of coax cable as described by "Cable Preparation and Assembly" after determining necessary routing.

Prepare the coax cable for the panel plug fitting as described in "Cable Preparation and Assembly for Panel Plug Connector P/N 162-1008". Assemble the panel plug as detailed in Figures 16 to 18. Secure the assembled panel plug to the mounting frame (See Figure 12). The panel plug connection is kept as a floating connection through the shoulder bushings. The connection will adjust itself once the receiver is inserted into the mounting frame. Run the coax cable to the antenna preamplifier and secure the BNC connector.

2.3.4.1 Cable Preparation and Assembly for BNC Connector
P/N 162-1009

- 1) Cut the cable end square. Remove jacket, braid, and cut dielectric $1/4"$. Cut cable jacket back only an additional $1/32"$. Be careful not to nick the braid. Flare the braid to accept the cone. Slit the jacket $1/4"$ in 2 places 180° apart. Tin the center conductor.

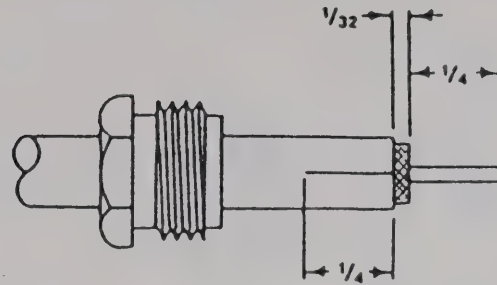


Figure 13

- 2) Slide the cone assembly under the braid until it touches the shoulder. Soft solder the contact to the center conductor.

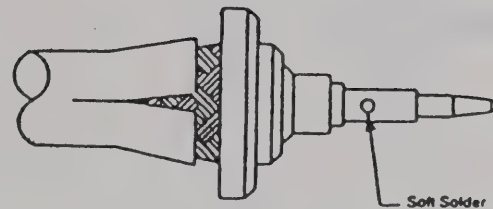
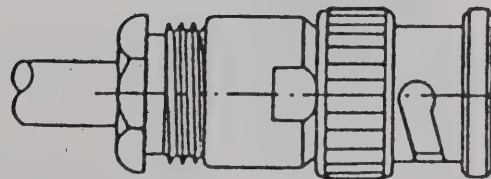


Figure 14

- 3) Slide the clamp nut over the flared portion of the cable. Thread the connector body onto the nut while holding the nut stationary. Tighten securely.



Attach to Preamplifier or Antenna

Figure 15

2.3.4.2 Cable Preparation and Assembly for Panel Plug Connector
P/N 162-1008

- 1) Cut the cable end square. Remove jacket, braid, and cut dielectric $1/4"$. Cut cable jacket back only an additional $1/32"$. Be careful not to nick the braid. Flare the braid to accept the cone. Slit the jacket $1/4"$ in 2 places 180° apart. Tin the center conductor.

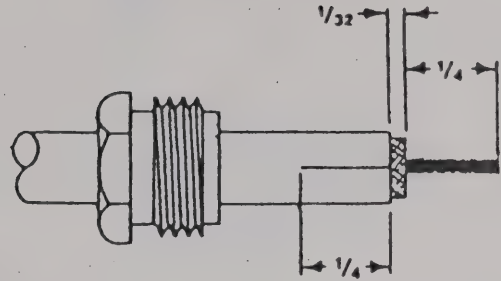


Figure 16

- 2) Slide the cone assembly under the braid until it touches the shoulder. Soft solder the contact to the center conductor.

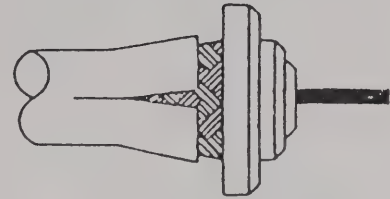
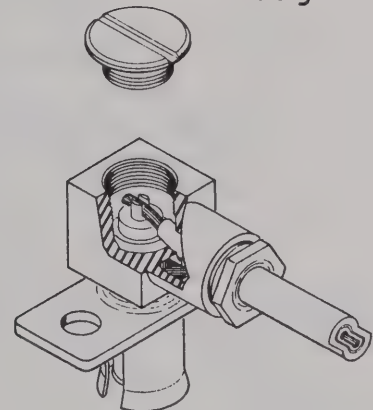


Figure 17

- 3) Slide the clamp nut over the flared portion of the cable. Thread the connector body onto the nut while holding the nut stationary. Tighten securely.



Attach to Back Panel of Mounting Frame.

Figure 18

**MOUNTING FRAME CONNECTOR PANEL
(REAR VIEW)**

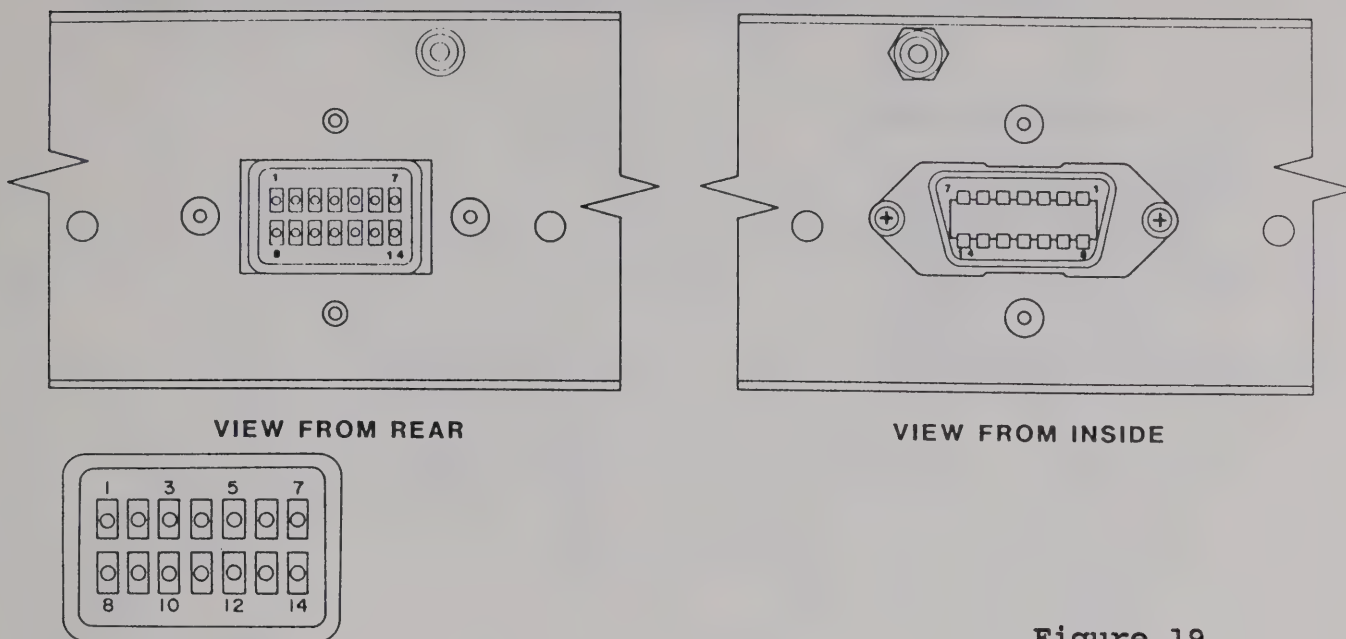


Figure 19

CONNECTOR PINOUT

REAR CONNECTOR PIN ASSIGNMENT

PIN NUMBER	FUNCTION
1	WAYPOINT ARRIVAL (ARIV)
2	+ (TO) (NAV VALID FLAG)
3	LORAN WARN
4	+ (RIGHT) (CDI VERTICAL POINTER)
5	+ (LEFT) (CDI VERTICAL POINTER)
6	RS-232 SERIAL DATA OUTPUT INTERFACE
7	DO NOT USE (INTERNALLY CONNECTED)
8	RS-232 GROUND
9	- (FROM) (NAV VALID FLAG)
10	SHIELD
11	NO CONNECTION
12	GROUND
13	NO CONNECTION
14	A+ POWER INPUT (12 VDC or 28 VDC)

Figure 20

INSTALLATION WIRING DIAGRAM FOR THE APOLLO MODEL 604

Optional Dimmer Circuit

Use a 1N2980 16V 10W Zener Diode for 28V installations or a 1N2970 6.8V 10W Zener Diode for 14V installations. Use a heat sink with the zener.

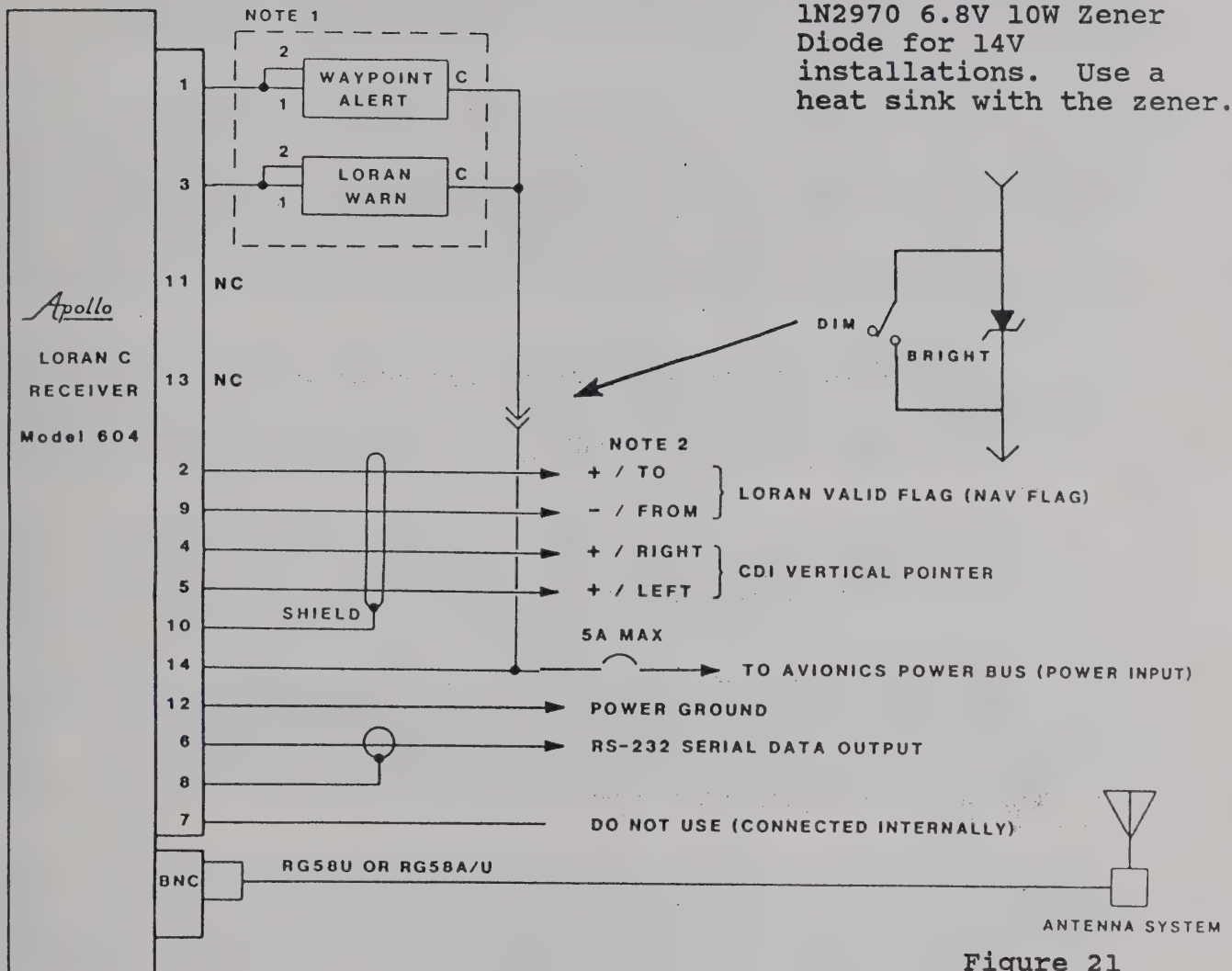
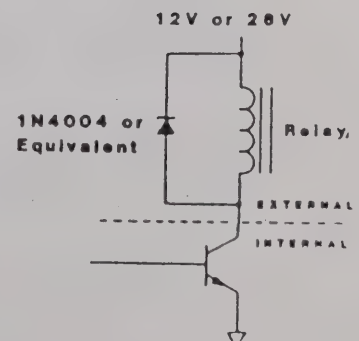


Figure 21

NOTE 1: Use 12 or 28 Volt indicator lamps or relays depending on the supply voltage. Lamps or relays MUST NOT draw more than 180 mA each. If a relay is used, a diode must be placed across the relay as shown. A relay meeting MIL-STD-202B is approved. An example is: Potter & Brumfield R 10-E1-V430 24VDC 6PDT (24 V application).



NOTE 2: Due to the diversity of CDI movements available the following notes on CDI/AUTOPILOT/HSI Interface may be used to guide the installer for the application necessary. CDIs that have separate TO/FROM and NAV VALID FLAG movements require the use of the FC-02 Low Level Flag Adapter or the FC-01 Superflag Adapter. The FC-01 Superflag Adapter must be used when interfacing with an autopilot that requires a superflag input. The MD40-10(L) LORAN CDI is designed for use with the APOLLO Model 604 and provides LORAN Valid/OFF, Left/Right needle movement, and LORAN WARN and Waypoint Arrival annunciators.

2.3.4.3 CDI/AUTOPILOT/HSI INTERFACE

The APOLLO LORAN-C receiver will interface with low level (± 150 uA) CDI and HSI meters. The wiring diagram shown above indicates the pins to be connected. The APOLLO LORAN-C receiver CDI interface will not operate with units that have internal CDI or HSI conversions. CDIs with 200 ohm TO/FROM meter movements require a 750 ohm resistor (1/8 or 1/4W) in series with the TO/FROM movement.

HSI systems may be connected in parallel to the Left/Right connections (Pins 4 and 5). Autopilots may then be connected to the appropriate outputs of the HSI. Follow the Autopilot or HSI manufacturer's directions. Up to four 1 K ohm loads may be connected between the LEFT/RIGHT (5,4) pins.

The only proper flags that will appear for LORAN-C information are: "OFF", "FROM", and "TO". When using a CDI that has a 200 ohm/250 mV meter movement specification, the APOLLO LORAN-C receiver output will drive only one NAV flag.

CDIs with a single integral TO/FROM and OFF movement: Pin 2 (+TO) of the 14-pin connector should connect to the CDI "+TO" and Pin 9 (-FROM) should connect to the CDI "+FROM". The "TO" or "FROM" flag will appear whenever LORAN-C steering information is valid. Up to four 1 K ohm loads may be connected between the TO/FROM (2,9) pins.

CDIs with separate TO/FROM and NAV VALID FLAG movements require the use of the FC-02 Low Level Flag Adapter. Pin 2 (+TO) of the APOLLO 14-pin connector should connect to the CDI "+TO" and to the BLUE wire of the FC-02. Pin 9 (-FROM) should connect to the CDI "-FROM" and to the ORANGE wire of the FC-02. The YELLOW wire from the FC-02 should connect to the CDI "-NAV" and the GREEN wire should connect to the CDI "+NAV" input. See figures 22 and 23 for connection examples. Only one CDI NAV VALID flag may be driven in this configuration.

The wiring diagram for the FC-01 Superflag Adapter and the MD40-10(L) LORAN CDI are shown on the following pages.

LORAN/CDI INTERCONNECTION

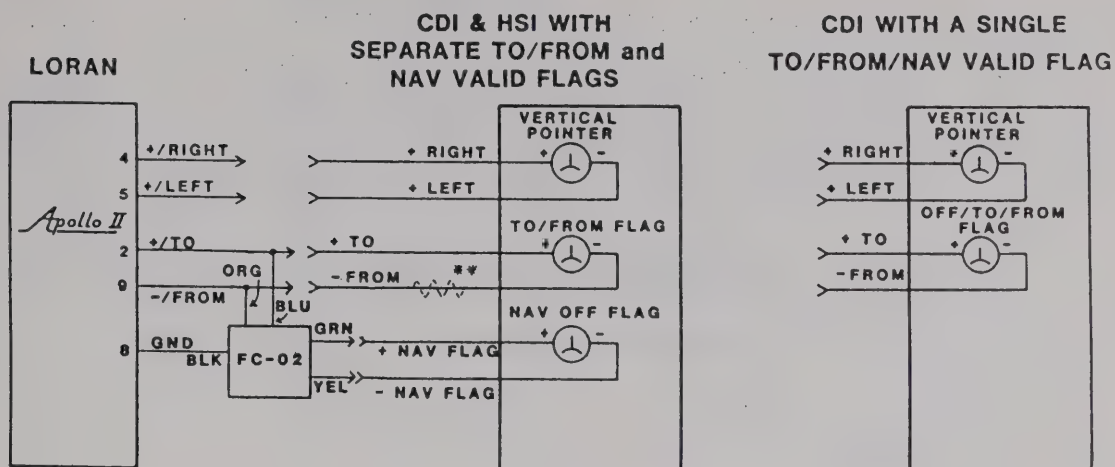


Figure 22

LORAN/NAV/CDI INTERCONNECTION

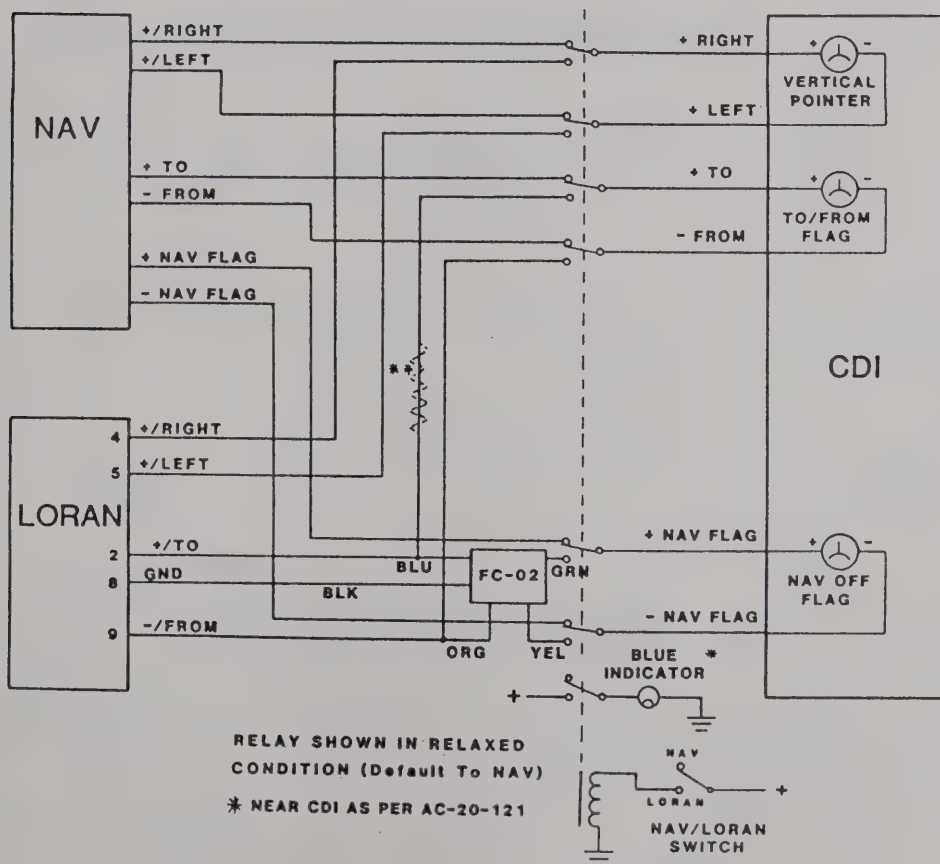


Figure 23

FC-01 INTERCONNECTION

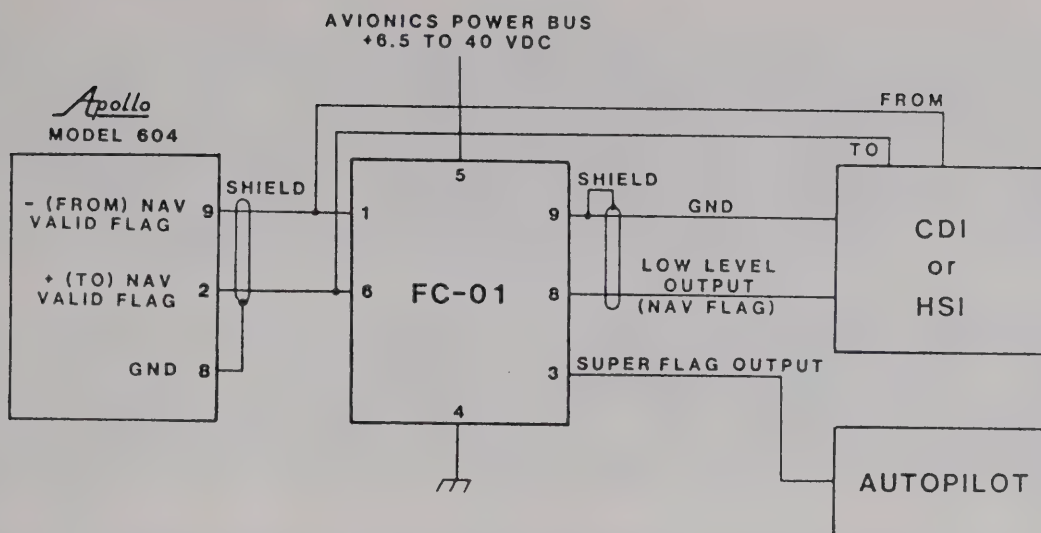


Figure 24

MD40-10 AND MD40-10L INTERCONNECTION

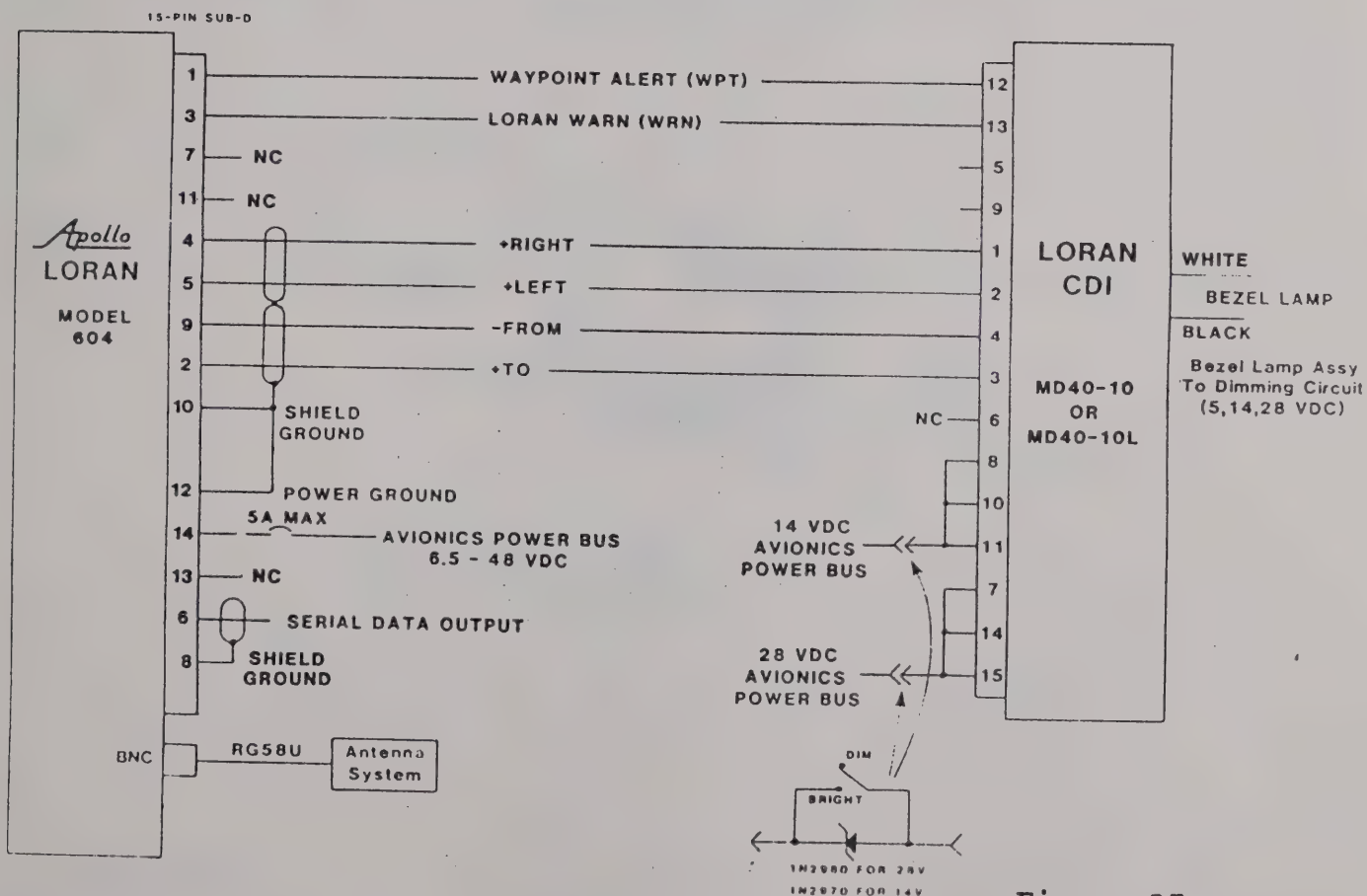


Figure 25

2.3.5 AIR COOLING

It is recommended, but not required, to use air cooling such as ram air or a fan to enhance the life of the electronic components within avionics. Since heat is a major enemy of electronic equipment, the reliability and longevity of avionics will be increased with any reduction in heat. The removal of heat by air circulation between avionics units will be enhanced by separating components by 1/4". Excessive heat under operating conditions will be avoided if a cooling system is used.

The APOLLO Model 604 has an air cooling input for connection by tubing to either ram air or a fan to allow cooling to the unit. The cooling air is brought to the unit by 5/8" tubing. Connection is made by pressing the tubing over the exposed air connector. On the top right side at the rear of the unit an air exhaust port is provided to allow the cooling air to exit. Do NOT cover this opening.

It is recommended to use a method which will produce the best cooling efficiency. Follow all of the manufacturer's installation directions carefully and use good aviation installation practices. If a ram air system is used it should be a type that is water-free and filtered.

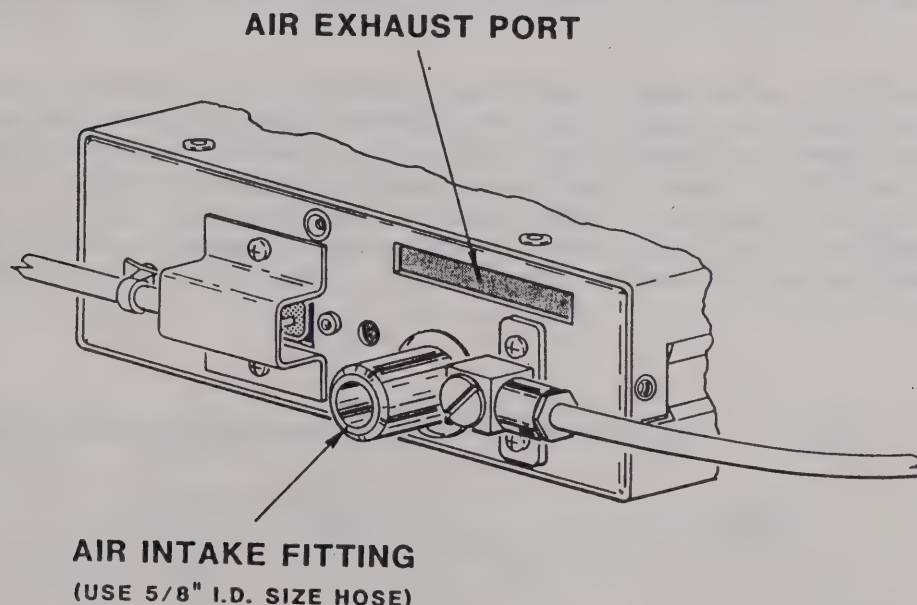


Figure 26

2.3.6 HELICOPTER INSTALLATION

The installation of LORAN-C receivers in helicopters requires specialized procedures as helicopters possess special problems. The major problem in LORAN-C use for helicopters is in the size and placement of the antenna. An additional problem is in providing an adequate ground for the antenna in many helicopters.

An antenna location on the topside of the helicopter is preferred. The antenna is best located as high as possible. Bottom mounted antennas may not receive a good signal while the aircraft is on the ground. Bottom mounting provides more restricted space and requires an antenna with less vertical height, such as the A-17 Blade or A-23 Bent Whip Antenna. Bottom mounted antennas should be placed as far away from obstructions as possible. Be sure to also avoid the engine exhaust area.

CAUTION: Bottom mounted antennas cause inversion of the LORAN-C signal. A jumper connection on the Digital Board of the APOLLO Model 604 will compensate for the signal inversion see Figure 3. This internal connection change MUST ONLY be performed by the factory, a factory authorized repair station, or authorized dealer.

The antenna should be attached to structural metal for a common ground. If this is not possible, a metal plate or screen may need to be used to create a ground plane. The antenna ground must be connected to the preamplifier ground if a separate preamplifier is used.

The diagram below shows four possible antenna locations. Other locations may also provide good reception and proper installation. Choose the most practical site that will yield the best results. Be sure to avoid locating LORAN-C antennas too close to VHF or HF radio antennas. A safe distance for the LORAN-C antenna is at least 6 inches from a transmitting antenna emitting 25 W or less, and at least two feet away from a high power transmitting antenna.

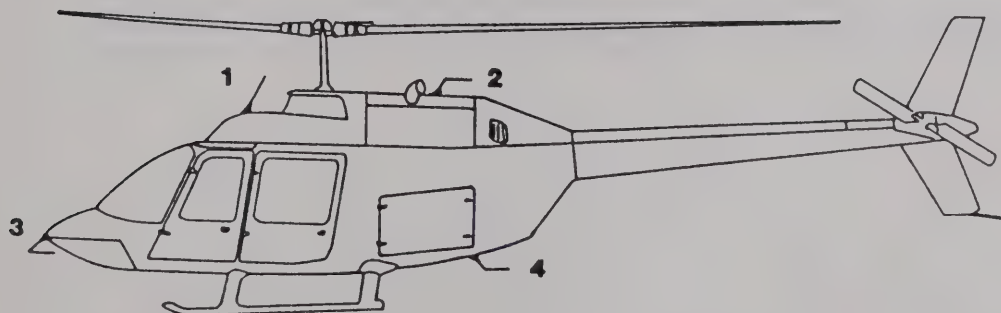


Figure 27

2.4 INSTALLATION CHECKOUT

This section describes a quick operational checkout to verify proper installation. If all installation manual instructions have been followed, proper operation of the APOLLO Model 604 is assured. This procedure does not provide a checkout of all operations of the APOLLO Model 604, but provides a quick indication of correct installation. This checkout should be completed before the work area has been sealed should a problem occur. If you are unfamiliar with the unit, read the applicable sections in the Operation Handbook.

1. Check all power and ground connections before applying power.
2. Turn the power on.
3. Check and record the Signal Levels and SNRs. Note the time necessary to cycle select. Perform this procedure with all other avionics off.
4. Check the position display with a known position coordinate. Do this by comparing the APOLLO Model 604 with another II Morrow LORAN-C receiver or by placing the aircraft near the Airport Reference Point. Do not perform this test inside a hangar or next to large buildings.
5. Define a distant waypoint as the destination and present position as the origin. Compare the bearing and range displayed with calculated values.
6. Check the CDI interface, if used.
 - a. Enter a course offset (OFST) of 3.0 nm to the left. You should note a 3-dot needle deviation to the left. The XTD display should also show an indication to steer left.
 - b. Enter a course offset of 3.0 nm to the right. You should note a 3-dot needle deviation to the right. The XTD display should also show an indication to steer right.
 - c. Return to no course offset. The CDI needle should be centered and the XTD display should indicate you are on course.

7. Turn off the APOLLO Model 604. Turn on all other avionics. Turn on the APOLLO. Note the time needed for cycle selection to be completed. Also, check the Signal Levels and SNRs. Then compare the cycle selection time, the Signal levels and SNRs with those taken with the other instruments off. Cycle select times should both be within proper tolerance (for each cycle selection the time needed will be slightly different). Proper cycle select is from approximately 2½ to 5 minutes. Signal levels should be within 10 units with the other aircraft avionics either on or off. SNRs should read close to the same values with the other aircraft avionics either on or off (within ten units). SNRs may read a little lower than before due to the increased noise of the added equipment.
8. If the signal quality readings indicate a problem:
 - a. Review all installation procedures carried out.
 - b. Check all connections.
 - c. Turn on the avionics one at a time to isolate the interference source and correct the problem.

Note: Interference may be caused by the improper installation of other avionics or poor bonding of the aircraft ground.

2.5 FLYBRARY CARTRIDGE REPLACEMENT

The APOLLO Model 604 allows for the replacement of the FLYBRARY cartridge by the user. The cartridge is plugged into a slot in the back panel of the Model 604. The unit will function properly as a LORAN-C receiver with or without the FLYBRARY cartridge in place. The FLYBRARY waypoints will only be available with the FLYBRARY cartridge inserted. USER Region waypoints are available whether the FLYBRARY cartridge is installed or not. Replacement of the FLYBRARY cartridge will not erase the USER Region waypoints.

FLYBRARY CARTRIDGE REPLACEMENT

1. Turn the power off to the unit.
2. Use a small flat blade screwdriver and loosen the locking screw on the upper center of the front panel.
3. Pull the unit out of the mounting tube.
4. Locate the FLYBRARY cartridge on the upper right corner of the back panel.
5. Use a phillips screwdriver and loosen the two screws on either side of the cartridge.
6. Insert blade of a small flat blade screwdriver in the slot on the lower edge of the cartridge housing and gently pry the cartridge out of the unit. DO NOT TOUCH THE PINS IN THE CARTRIDGE HOUSING.
7. Carefully slide the new FLYBRARY cartridge into the slot. DO NOT TOUCH THE PINS IN THE CARTRIDGE HOUSING.
8. Replace the screws that hold the cartridge in place.
9. Return the unit into the mounting tube and tighten the locking screw on the front panel.
10. Perform the checkout of the new FLYBRARY cartridge as described in the installation sheet that came with it.

